

**The State of Maine  
Maine Department of Transportation**

**WALDO HANCOCK BRIDGE  
REMOVAL  
STRUCTURAL ENGINEERING**

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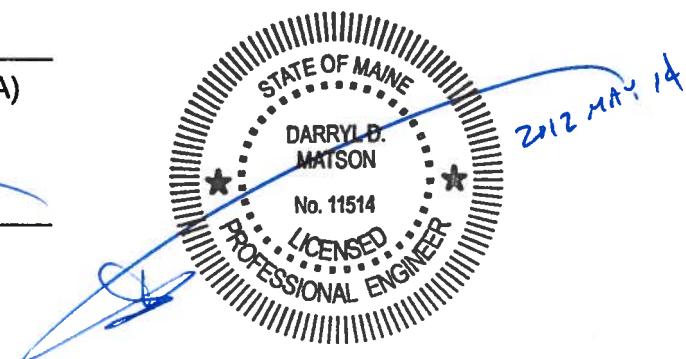
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## 1. Introduction

The Maine Department of Transportation (MaineDOT) requested engineering assistance for the removal of the Waldo Hancock Bridge structure. The anticipated scope of the demolition includes the removal of the deck, stiffening truss, main cables, suspenders, viaduct approach spans, towers, cable bents and bent footings; leaving only the abutments, tower foundations, and cable anchorages at the end of the removals.

The scope of this engineering assignment included evaluating the stability of the suspension bridge structure during all stages of a reasonable demolition sequence, and then preparing:

- This report, summarizing the step-by-step sequence of demolition, intended for use by MaineDOT as a record of the evaluation of the structure. This document will be made available to Contractors during the tender phase and demolition.
- Under separate cover, the Removal Plans (briefly described in Section 5.1.1) and Removal Sequence Schematics (briefly described in Section 5.1.2), intended for use by MaineDOT to develop project cost estimates and to include as a portion of the tender package to potential Contractors.

The demolition method for the approach viaduct structures will be strongly dependent upon the selected Contractor and contractual restrictions regarding access to the site. The configuration of the viaduct allows a variety of options for sequencing the demolition which will require assessment by the Contractor's engineer to satisfy the strength and stability of the viaduct structure at all of the Contractor's demolition stages. Devising a reasonable demolition sequence for the approach viaduct is beyond the scope of this engineering assignment, and will be the responsibility of the Contractor.

### 1.1 Objective

The objective of this report is to provide evidence to MaineDOT that the suspension bridge can be demolished within the bounds of a reasonable demolition sequence.

In order to achieve this objective, this report contains the following information for all demolition stages:

- Bridge Truss, Tower and Main Cable Geometry under Dead Load;
- Suspender forces (Dead & Wind Loads);
- Demand over Capacity (D/C) ratios for Truss Chords, Diagonals and Verticals (Dead & Wind Loads); and
- D/C ratios for Tower sections (Dead & Wind Loads).

In addition, a description of the computer model and the analysis methodology is presented.

## 2. Demolition Sequence Modeling

### 2.1 Structure Configuration

The computer model of the structure is based on our review of the numerous drawing packages and reports provided by MaineDOT. Highlights of the structural configuration include the following features:

- The existing condition obtained from the original design drawings and subsequent modifications indicated on the rehabilitation design drawings;
- The supplemental cables are working with the original cables;
- The original cables have deteriorated, but the overall loss of strength or stiffness is not defined in previous reports;
- The concrete deck has been modified several times from the original slab. The replaced deck (1962) has been resurfaced and recently the concrete sidewalks have been removed to reduce the dead load of the bridge; and
- The suspenders were replaced in 2002.

### 2.2 Loading on Structure

#### 2.2.1 Dead Load

The dead load condition accounts for the weight of materials from the original construction, rehabilitation of the deck, and the addition of the supplemental cables as shown on design drawings. Additional loads, from field observations, were included to account for catwalks on the suspension cables.

In the computer model, the distribution of the dead loads between the original and supplemental cables reflects the geometry and cable tension information indicated on the 2002 design drawings.

#### 2.2.2 Wind Load

The wind climate data and wind speeds from "A Study of Wind Effects for Prospect Verona Bridge Maine, USA" BLWT-SS5-2005 / February 2005, by Alan G. Davenport Wind Engineering Group were

used to determine appropriate wind loading for various stages of the engineering analysis of the bridge demolition.

The wind speed return period for various stages of the bridge demolition is not specifically described in design codes. Common return periods for new structures include 1/100 years for design and 1/10 years for construction. For active demolition stages the use of 1/10 year wind speeds is considered reasonable.

#### 2.2.3 Demolition Equipment

Equipment loads on the bridge deck for preparatory work have been assessed on the basis of limiting loads to one piece of equipment weighing less than 100,000 pounds including payload, centered transversely on the bridge. Localized effects from vehicles and loading on the bridge deck are the responsibility of the Contractor.

As the stringers are cut, equipment is not allowed past the cut line of the stringers.

Equipment in excess of 10,000 pounds total is not permitted on the bridge deck, trusses, suspenders, suspension cables, cable bents or the towers during cutting and removal of the truss and cable sections. This work is envisioned to be performed using barge mounted and land based cranes.

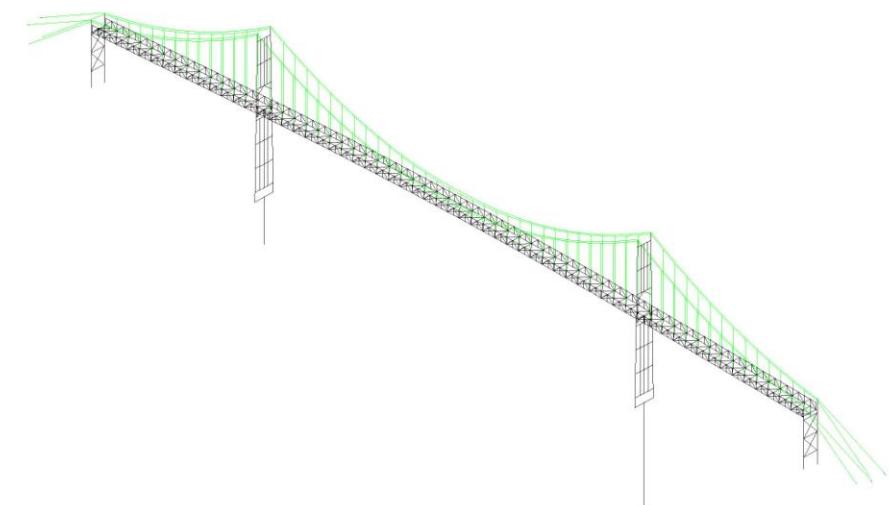
## 2.3 Structure Computer Models

### 2.3.1 Original Dead Load Model

The development of the computer model is based on the following assumptions:

- The existing condition is representative of the original and rehabilitation design drawings; and
- The degradation of the original main cables is not documented, but an assumption for the stretch of the main cables since original installation and the reduction in stiffness due to corrosion is included. To account for corrosion and breaking of the individual wires in the cables the axial stiffness of the original cables has been reduced to 90% of the original values. Long term stretch of the original cables has been included at 0.015%.

The suspended spans of the Waldo Hancock Bridge were modeled in three dimensions as shown in Figure 1. The model consists of 2590 nodes, 2162 3D beam elements, and 362 cable elements.



**Figure 1: Computer Model Structure**

The various idealizations and assumptions of the model are briefly discussed below:

- Fins and buttresses are not included in the tower leg properties and capacities;
- Loss of section is not considered in calculations of the properties and capacities except for the original cables;
- Although the supplementary cables were input based on the geometry and cable lengths provided on the drawings, the supplementary cable backstay lengths before connection to the main cables were adjusted to match the cable tensions shown on the rehabilitation design drawings;
- Original cable axial stiffness is reduced by 10% to account for general deterioration of the cable wires;
- Original cables are elongated by 0.015% to account for long-term cable stretch;
- Design properties are used for supplemental cables and suspenders, with no deterioration or long-term stretch;

- Connections between truss members are assumed to be pin connections;
- Structural steel strength:  $F_y = 36\text{ksi}$ ,  $F_u = 58\text{ksi}$ ;
- The critical buckling loads for the tower legs were assessed based on second order stability analysis for a series of axial loads and tower top displacements;
- Wind gust coefficient of 2.0;
- Wind drag coefficient of 2.0 for towers;
- Wind drag coefficient of 1.0 for cables (accounting for attachments & changes to cable surfaces);
- Lateral, longitudinal & 45 degree wind considered; and
- Shielding: approximately 50% for leeward truss & tower leg.

The dead load model of the original bridge matched the geometry shown on the original design drawings.

### 2.3.2 Methodology

The methodology used to compute the geometry and stresses at various stages of the demolition of the Waldo Hancock Bridge was as follows:

- Assemble all the information required for the generation of complete or partial bridge models at any point in time, including the derivation of all the information necessary to compute all the section capacities;
- Generate and run the dead load model for the complete bridge and validate this model against information from the as-built drawings;
- Tune the dead load model to obtain existing geometry and forces;
- Define a workable demolition sequence in  $n$  stages, which for complete removal of the original cable turned out to be 73 stages;
- Assemble the computer models for each demolition stage, determine the deflected shape of the bridge and the D/C Ratios for Truss and Tower members and suspenders; and
- Produce a plot of D/C ratios and geometry for each stage.

### 2.3.3 Demolition Sequence Models

The demolition sequence models are based on the original dead load model with structural components removed or modified in the computer model to reflect the demolition procedure and stage.

The demolition sequence stages are listed in Section 3.2.

## 2.4 Computer Software and Data

The demolition analyses were performed using the Buckland & Taylor Ltd. proprietary nonlinear analysis program CAMIL and bridge sequence generation program ERC95. Both of these programs are briefly introduced below.

### 2.4.1 Nonlinear Analysis Program CAMIL

Buckland & Taylor Ltd.'s in-house bridge analysis program CAMIL has been developed over more than three decades to facilitate the analysis of a large variety of bridges. The program has many bridge specific features which have been enhanced over the years to provide a versatile analysis tool. Numerous tests have been carried out to verify the program's performance against other commercial programs such as ADINA. In addition, it should be noted that the program has been validated both statically and dynamically through comparisons with measured responses of several full scale structures.

With its built-in nonlinear cable elements, the program has been used extensively for the design, erection, demolition and evaluation of numerous suspension and cable-stayed bridges. The program has been used as the analysis engine for the modeling of more than a dozen suspension bridges. Excellent correlation has been achieved with cable tensions measured in the field. Behavior of the cables with low tension (large sag) near the completion of the Waldo Hancock Bridge demolition is accurately modeled with the software used for the analyses.

### 2.4.2 Stage Generator Program ERC95

The program ERC95 generates the CAMIL model and load cases for each demolition stage. The program then runs the CAMIL analysis and processes the structural analysis output to verify the viability of the erection stage. The program automatically processes all stages in the demolition sequence and produces summary plots and files for each stage.

### 3. Demolition Sequence Stage Plots

This section contains results of the analysis for the demolition stages for the Waldo Hancock Bridge in graphical form. The results for each of the demolition stages are checked against the criteria and then shown graphically on each stage specific plot. This information will be made available to Contractors during the tender phase and demolition of the structure.

#### 3.1 Description of Demolition Sequence Stage Plots

##### 3.1.1 Overview

For each assumed demolition stage of the Waldo Hancock Bridge, an analysis has been carried out and the results of this analysis are summarized on a single stage plot. A typical stage plot is shown in Figure 2 where the main areas of the plot are identified.

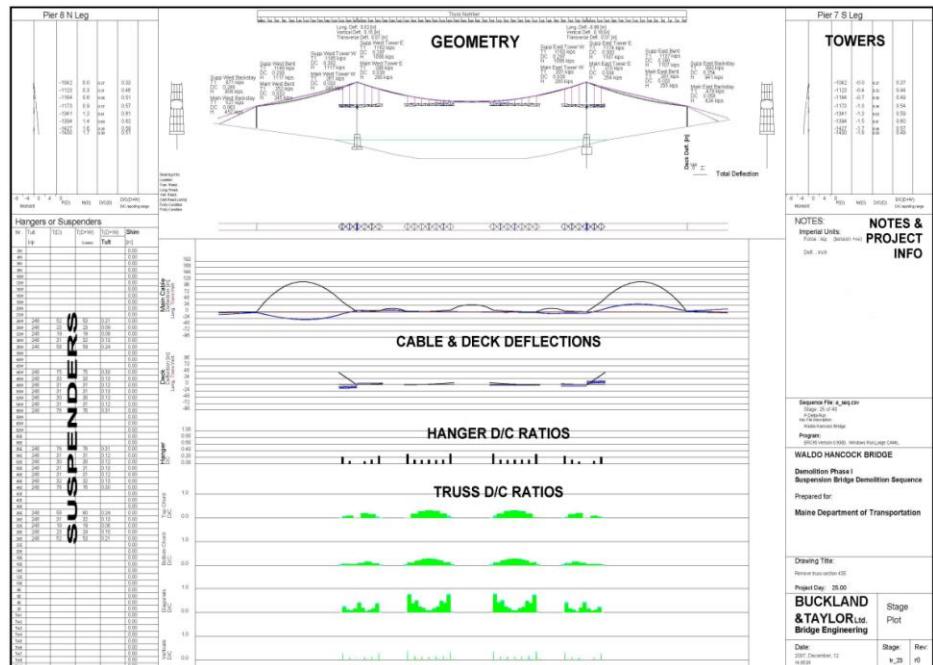


Figure 2: Overview of a Typical Demolition Sequence Stage Plot

The information presented in these areas is described in more detail in the following sections. A typical plot contains the following information:

- Notes, stage identification and project information;
- Dead load deformed geometry of the elevation of the entire structure;
- Tower moments, axial loads and D/C ratios (demand/capacity);
- Main cable and supplementary cable deflections;
- Deck deflections;
- Suspender tensions, ultimate capacity and D/C ratios; and
- D/C ratios for the truss members.

##### 3.1.2 Notes and Project Information

The information on the right hand side of each plot (shown in Figure 3) is broken down as follows:

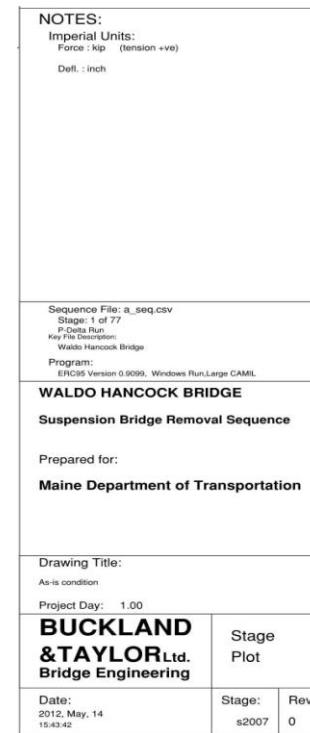


Figure 3: Notes and Project Information

#### Notes

- **Units:**  
The units used to plot axial force and deflections in this submission are expressed in kips and inches. Note that moment is expressed in units of kip-ft x 10<sup>3</sup>.
- **Sequence File:**  
This section identifies the generation sequence file used to prepare the model for the analysis, analysis stage and total number of stages in the sequence. The sequence file name is given to provide cross reference to computer analysis input files.
- **Key File:**  
This section identifies the key file which references all the input data files used for the analysis.
- **Program Version:**  
Defines the version of the program ERC95.

#### Bridge Name and Owner

This section identifies the bridge and its owner.

#### Plot Title and Project Day

This section gives the description of the stage analysis and the project day which corresponds to that stage. The project day is only used to indicate the stage sequence and does not refer to actual days of the project. This is followed by our Company logo.

#### Date, Stage and Revision

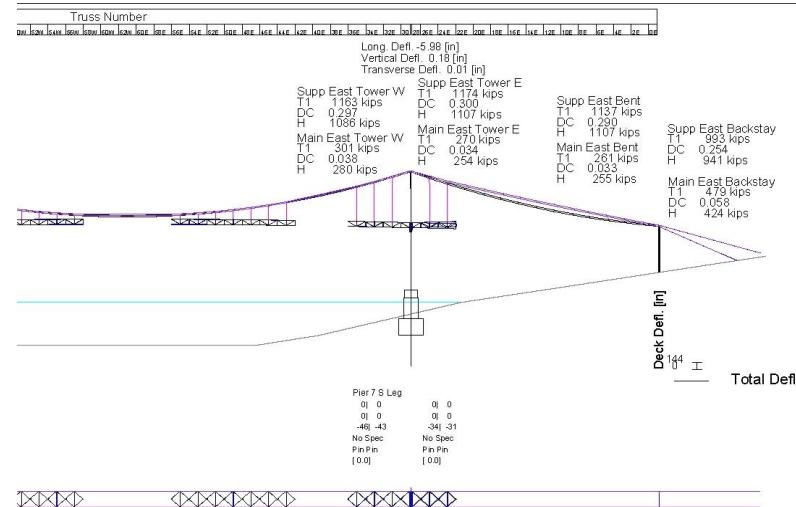
This section defines the date and time when the analysis was performed, the name of the construction stage and the revision number for that stage.

### 3.1.3 Geometry

The geometry section of the plot displays the elevation and plan views of the bridge, with both the deformed and un-deformed shape of the structure for that stage (see Figure 4). The un-deformed geometry is drawn in thin lines and the deformed shape of the structure is shown using thicker lines. The deformations are shown to scale. A deformation scale is provided on the right side of the geometry section. Numeric values of the tower top deflections for the dead load condition are shown adjacent to the towers.

Cable information is provided for segments adjacent to the cable bents and towers for the original cables and the supplemental cables. Numeric values for the cable tension, D/C ratio and horizontal component of the tension force are shown.

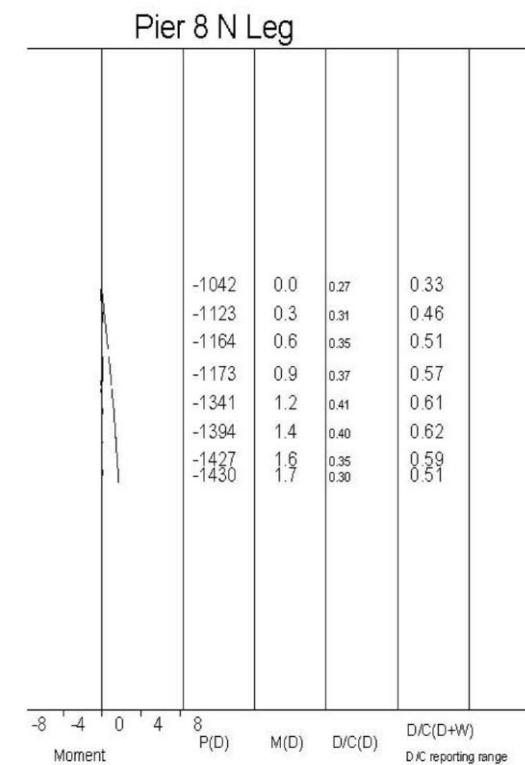
For ease of reference, the truss section numbers are listed above the elevation view.



**Figure 4: Geometry**

### 3.1.4 Towers

Information regarding the towers of the bridge is shown in the upper corners of the plot as shown in Figure 5. The left-most section of the tower plot shows the longitudinal dead load moments in the tower leg. The next column labeled P(D) gives the axial dead load in the tower legs at selected locations (in kips). The column labeled M(D) gives the longitudinal dead load moments (in kip-ft  $\times 10^3$ ). The column labeled D/C(D) gives the D/C ratios for selected sections under dead load. The column labeled D/C(D+W) gives the D/C ratios at selected sections for combinations of dead and wind loads (longitudinal, 45 degrees and transverse).



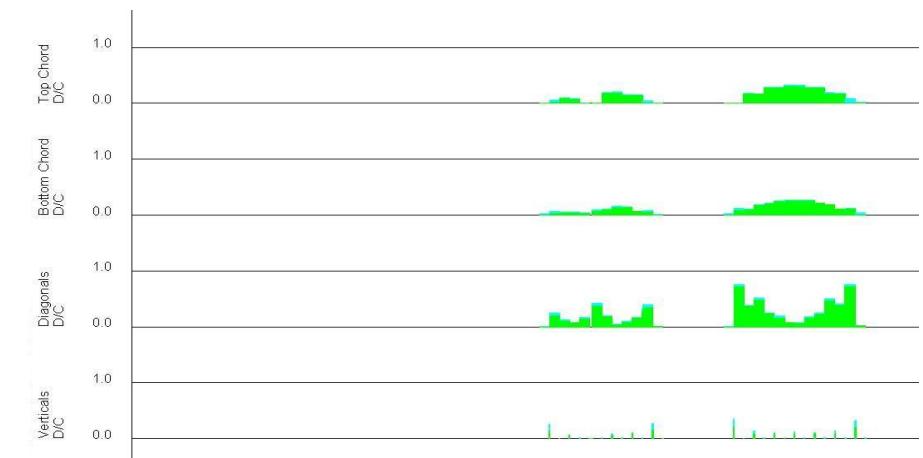
**Figure 5: Towers**

### 3.1.5 Truss D/C Ratios

The truss D/C ratios for combined dead and wind loads are shown for the individual truss members in four different groups:

- Top Chords;
- Bottom Chords;
- Diagonals; and
- Verticals.

Descriptions of the individual member groups are provided at the left hand side of the truss D/C section as shown in Figure 6. For the truss members, D/C ratios corresponding to dead load are shown in green while the D/C ratios for dead and wind load combinations are shown in blue.



**Figure 6: Truss D/C Ratios**

### 3.1.6 Suspenders

A typical suspender section of the demolition stage plot is shown in Figure 7. In this section, the first column contains the suspender number. In the second column, the ultimate capacity,  $T_{ult}$ , for each suspender is given. The tension in the cable under all dead load effects at that stage,  $T(D)$ , is given for each suspender in the third column. The fourth column summarizes the maximum load in the suspender under combined dead and wind loads,  $T(D+W)$ . The heading for this column also indicates the number of wind load cases considered in the analysis. The D/C ratio of dead and wind load to the ultimate capacity,  $T(D+W)/T_{ult}$ , is shown in the fifth column. The sixth column contains shim values which are not used in this analysis.

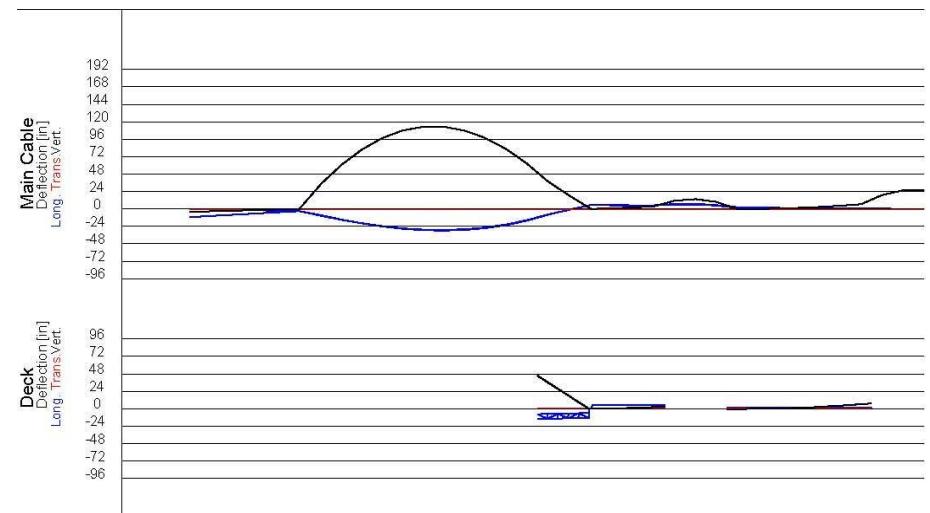
Hangers or Suspenders					
Nr.	Tult kip	T(D)	T(D+W) 3 cases	T(D+W)	Shim [in]
				Tult	
2W				0.00	
4W				0.00	
6W				0.00	
8W				0.00	
10W				0.00	
12W				0.00	
14W				0.00	
16W				0.00	
18W				0.00	
20W				0.00	
22W				0.00	
24W	248	52	53	0.21	0.00
26W	248	23	23	0.09	0.00
32W	248	19	19	0.08	0.00
34W	248	31	32	0.13	0.00
36W	248	58	59	0.24	0.00
38W				0.00	
40W				0.00	
42W				0.00	

Figure 7: Suspenders

### 3.1.7 Cable and Deck Deflections

The longitudinal, transverse and vertical deflections for both the original and supplemental cables are plotted on the graph labeled “Main Cable Deflection”, shown in Figure 8. The deck deflections are shown in Figure 8 on the graph labeled “Deck Deflections”.

Note that for stages cr01 and higher, the cable deflections reported on the stage plots are relative to the cable deflected shape for stage tr\_39. This has been done to address solution algorithm limitations associated with large cable movements.



### 3.2 Stage Plots

This section references plots showing the information described in the previous section for the complete demolition sequence, including the existing dead load configuration. This information is to support the engineering conducted to prove that the bridge remains stable throughout the sequence of removal of components, truss sections, cables and towers. This information will be provided to Contractors for tender and demolition purposes.

Demolition Sequence Stage Plots are shown in Appendix A.

The individual stages are listed below:

Stage Name	Description
s2007	As-is condition
prep	Demolition preparation
Note that for stages tr_01 and higher, the suspenders above removed truss sections are not shown on the stage plots due to the need to facilitate model solution algorithms. The suspenders will be present, as shown on the Removal Plans.	
tr_01	Cut & remove truss sections 0W-2W
tr_02	Cut & remove truss sections 0E-2E
tr_03	Cut & remove truss section 62W
tr_04	Cut truss between truss sections 14W & 16W
tr_05	Cut truss between truss sections 14E & 16E
tr_06	Cut truss between truss sections 36W & 38W
tr_07	Cut truss between truss sections 36E & 38E
tr_08	Cut & remove truss sections 4W-6W
tr_09	Cut & remove truss sections 4E-6E
tr_10	Cut & remove truss sections 8W-10W
tr_11	Cut & remove truss sections 8E-10E
tr_12	Cut & remove truss sections 58W-60W
tr_13	Cut & remove truss sections 58E-60E

Stage Name	Description
tr_14	Cut & remove truss sections 38W-40W
tr_15	Cut & remove truss sections 38E-40E
tr_16	Cut & remove truss sections 12W-14W
tr_17	Cut & remove truss sections 12E-14E
tr_18	Cut & remove truss sections 16W-18W
tr_19	Cut & remove truss sections 16E-18E
tr_20	Cut & remove truss sections 20W-22W
tr_21	Cut & remove truss sections 20E-22E
tr_22	Cut & remove truss section 42W
tr_23	Cut & remove truss section 42E
tr_24	Cut & remove truss section 44W
tr_25	Cut & remove truss section 44E
tr_26	Cut & remove truss sections 46W-48W
tr_27	Cut & remove truss sections 46E-48E
tr_28	Cut & remove truss sections 50W-52W
tr_29	Cut & remove truss sections 50E-52E
tr_30	Cut & remove truss section 24W
tr_31	Cut & remove truss section 24E
tr_32	Cut & remove truss sections 54W-56W
tr_33	Cut & remove truss sections 54E-56E
tr_34	Cut & remove truss sections 26W-28W
tr_35	Cut & remove truss sections 26E-28E
tr_36	Cut & remove truss sections 34W-36W
tr_37	Cut & remove truss sections 34E-36E
tr_38	Cut & remove truss sections 30W-32W
tr_39	Cut & remove truss sections 30E-32E

Stage Name	Description
cr01	Cut and remove cable sections 0W-4W
cr02	Cut and remove cable sections 4W-8W
cr03	Cut and remove cable sections 8W-12W
cr04	Cut and remove cable sections 12W-16W
cr05	Cut and remove cable sections 16W-20W
cr06	Cut and remove cable sections 0E-4E
cr07	Cut and remove cable sections 4E-8E
cr08	Cut and remove cable sections 8E-12E
cr09	Cut and remove cable sections 12E-16E
cr10	Cut and remove cable sections 16E-20E
cr11	Cut and remove cable sections 58W-62W
cr12	Cut and remove cable sections 54W-58W
cr13	Cut and remove cable sections 50W-54W
cr14	Cut and remove cable sections 46W-50W
cr15	Cut and remove cable sections 42W-46W
cr16	Cut and remove cable sections 38W-42W
cr17	Cut and remove cable sections 58W-62W
cr18	Cut and remove cable sections 54E-58E
cr19	Cut and remove cable sections 50E-54E
cr20	Cut and remove cable sections 46E-50E
cr21	Cut and remove cable sections 42E-46E
cr22	Cut and remove cable sections 38E-42E
cr23	Cut and remove cable sections 20E-24E
cr24	Cut and remove cable sections 24E-28E

<b>Stage Name</b>	<b>Description</b>
cr25	Cut and remove cable sections 34E-38E
cr26	Cut and remove cable sections 30E-34E
cr27	Cut and remove cable sections 20W-24W
cr28	Cut and remove cable sections 24W-28W
cr29	Cut and remove cable sections 34W-38W
cr30	Cut and remove cable sections 30W-34W
cr31	Cut and remove west original cable backstays
cr32	Cut and remove east original cable backstays

## 4. Discussion

The stage plots indicate the general condition of the main structural members of the trusses and tower legs during the demolition of the bridge. There are specific members selected for illustration due to their importance and the variability in the demands during the demolition process.

### 4.1 Main Bridge Structural Components

As illustrated in the Demolition Sequence Stage Plots, the Demand over Capacity (D/C) ratios for the main structural components remain acceptable for the demolition stages when assessed for dead load only and dead plus wind loads.

Unless otherwise noted, the design standard is AASHTO Standard Specifications for Highway Bridges, 17<sup>th</sup> edition – 2002, and members are evaluated according to Part C – Service Load Design Method (Allowable Stress Design).

A 125% increase of allowable stresses for dead plus wind loads is permitted for the existing structural components, except for cables and suspenders. The existing structural steel is assumed to have a yield strength of 36 ksi.

#### 4.1.1 Tower Legs

The tower legs are assessed for combined axial and biaxial bending affects compared to buckling analysis limits from bending stresses from AASHTO. The D/C ratio varies over the height of the tower leg as the section and demands change.

For demands due to dead load only, the D/C ratios reported in the stage plots must stay below  $1/1.25 = 0.8$ , representing the fact that the 125% overstress allowance is hardwired into the D/C ratio, even though it is not applicable to the dead load only condition.

For demands due to dead plus wind load, the D/C ratios reported in the stage plots must stay below 1.0, representing the fact that the 125% overstress allowance is hardwired into the D/C ratio.

#### 4.1.2 Truss Members

The truss members, top chord, bottom chord and diagonals are primarily governed by the axial forces. The continuous length of the truss during the demolition has a large influence on the dead load due to the changing geometry of the suspension cables. The member stresses are compared to AASHTO limits.

For demands due to dead load only, the D/C ratios reported in the stage plots must stay below  $1/1.25 = 0.8$ , representing the fact that the 125% overstress allowance is hardwired into the D/C ratio, even though it is not applicable to the dead load only condition.

For demands due to dead plus wind load, the D/C ratios reported in the stage plots must stay below 1.0, representing the fact that the 125% overstress allowance is hardwired into the D/C ratio.

#### 4.1.3 Suspenders

The D/C ratios for the suspenders are shown for D and D+W during the demolition sequence. The suspender tensions are compared to ASTM A-603 Minimum Breaking Load values.

D/C ratios reported in the stage plots must stay below 0.4, representing a factor of safety equal to 2.5 applied to the minimum breaking load.

#### 4.1.4 Cables

The D/C ratios shown for the suspension cables are for dead load only. The effect of wind on the tension in the cables is minor. The cable tensions are compared to ASTM A-586 Minimum Breaking Load values.

D/C ratios reported in the stage plots must stay below 0.4, representing a factor of safety equal to 2.5 applied to the minimum breaking load.

#### 4.1.5 Supplemental Cables

Removal of the supplemental cables will occur after the original cable backstays have been removed, and are not explicitly shown on the stage plots. There are several possible supplemental cable removal methods which can be considered. It is the responsibility of the Contractor to select the preferred removal method.

One possible method could include the following steps:

1. Release cable clamps on one line (corresponding to 4 strands) of supplemental cable saddles to Piers 6, 7, 8 and 9.
2. Support, cut and remove sections of the supplemental cable, one strand at a time, in the central portion of the main span. Remaining portions of strand between cuts and towers can be allowed to swing down, or lowered, towards tower.
3. Remove the remainder of each strand over the tower and side span.
4. Repeat above steps for the remaining three lines of supplemental cables.

A schematic of this is shown sheet B10 of the Removal Plans for the Waldo Hancock Bridge. For additional details on this package, see Section 5 of this report.

## 4.2 Secondary Bridge Structural Components

### 4.2.1 Tower Framing

The tower framing includes the cross beams between the tower legs and the verticals between the crossbeams. The loads in these elements do not approach the expected design loads. Movements of the bridge, specifically the tower legs, imparts little load in these elements and with reduced dead, live and wind loads are not a governing condition.

### 4.2.2 Cable Bents

The loads in the cable bent members during the demolition do not approach the original design loads from dead, live and wind loads.

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The cable bents are pinned at the base, therefore not inducing additional moments in the column legs due to movements of the top of the cable bent due to changes in tension of the cable system.

#### **4.2.3 Floor System**

A primary function of the floor system, stringers and floorbeams, is to distribute live loads from the deck to the trusses. During the demolition sequence the local dead load reduces slightly and the global change is minimal, therefore, D/C ratios are not assessed. The Contractor shall consider local and global effects on these elements due to the Contractor's procedures.

### **4.3 Primary Constraints**

#### **4.3.1 Structural Constraints**

Cutting the truss at selected locations along the suspension bridge, as shown in stage plots tr\_04 to tr\_07, is necessary to relieve dead load demands in the truss that increase over several stages of truss removal causing the large changes in the geometry of the bridge.

The pattern of removing truss sections in an alternating manner between both side spans and the main span is necessary to control out-of-balance loads in the spans. Dead load demands in the truss and longitudinal moment demands in the towers can grow to unacceptable levels when the sequence of truss removal continues in one span, producing an unbalanced situation.

#### **4.3.2 Environmental Constraints**

MaineDOT has requested that no portion of the existing bridge be allowed to fall into the river below during demolition operations. As such, the staging sequence as described in Section 3.2 and as seen in the stage plots in Appendix A has been developed. Actual methodology on how this is completed, such as positioning of cranes and barges, shall be determined by the Contractor.

## 5. Contract Package

### 5.1 Structural Contract Package

The content of the Removal Plans and Removal Sequence Schematics submission addresses structural issues for the demolition of the viaducts and suspension bridge. This submission may become a part of the MaineDOT project contract package.

#### 5.1.1 Removal Plans

This section lists the Removal Plans for the Waldo Hancock Bridge, which are submitted separately. These plans represent the demolition scope, including the sequence of demolition and final condition.

The individual drawings are listed below:

Sheet Number	Description
B1	Title Sheet
B2	General Notes
B3	General Arrangement-Existing Bridge
B4	General Arrangement-End of Removals
B5	General Arrangement-Salvage
B6	Truss Removals – Sheet 1
B7	Truss Removals – Sheet 2
B8	Truss Removals – Sheet 3
B9	Cable and Tower Removals – Sheet 1
B10	Cable and Tower Removals – Sheet 2
B11	Cable and Tower Removals – Sheet 3

#### 5.1.2 Removal Sequence Schematics

This section lists the Removal Sequence Schematics for the Waldo Hancock Bridge, which are submitted separately. The plots represent the demolition sequence described in the Removal Plans,

illustrating the sequence of truss section, cable and tower removal to achieve the intended condition of the bridge for the end of project.

These schematics are to provide MaineDOT and the Contractor a 3D image of the movements of the various components of the bridge with the removal of the truss sections and cables.

The individual schematic stages are numbered the same as previously listed in Section 3.2.

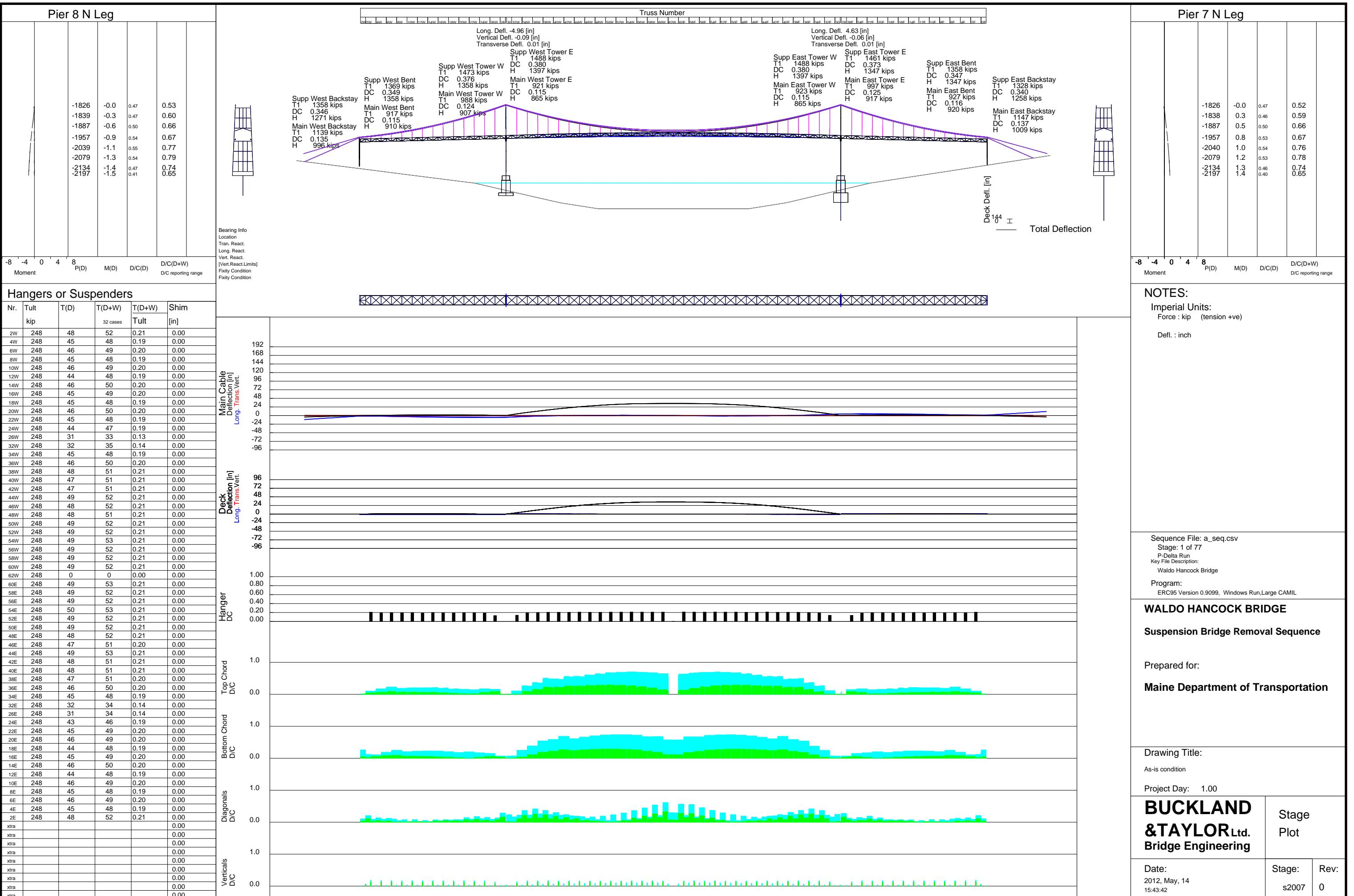
### 5.2 MaineDOT

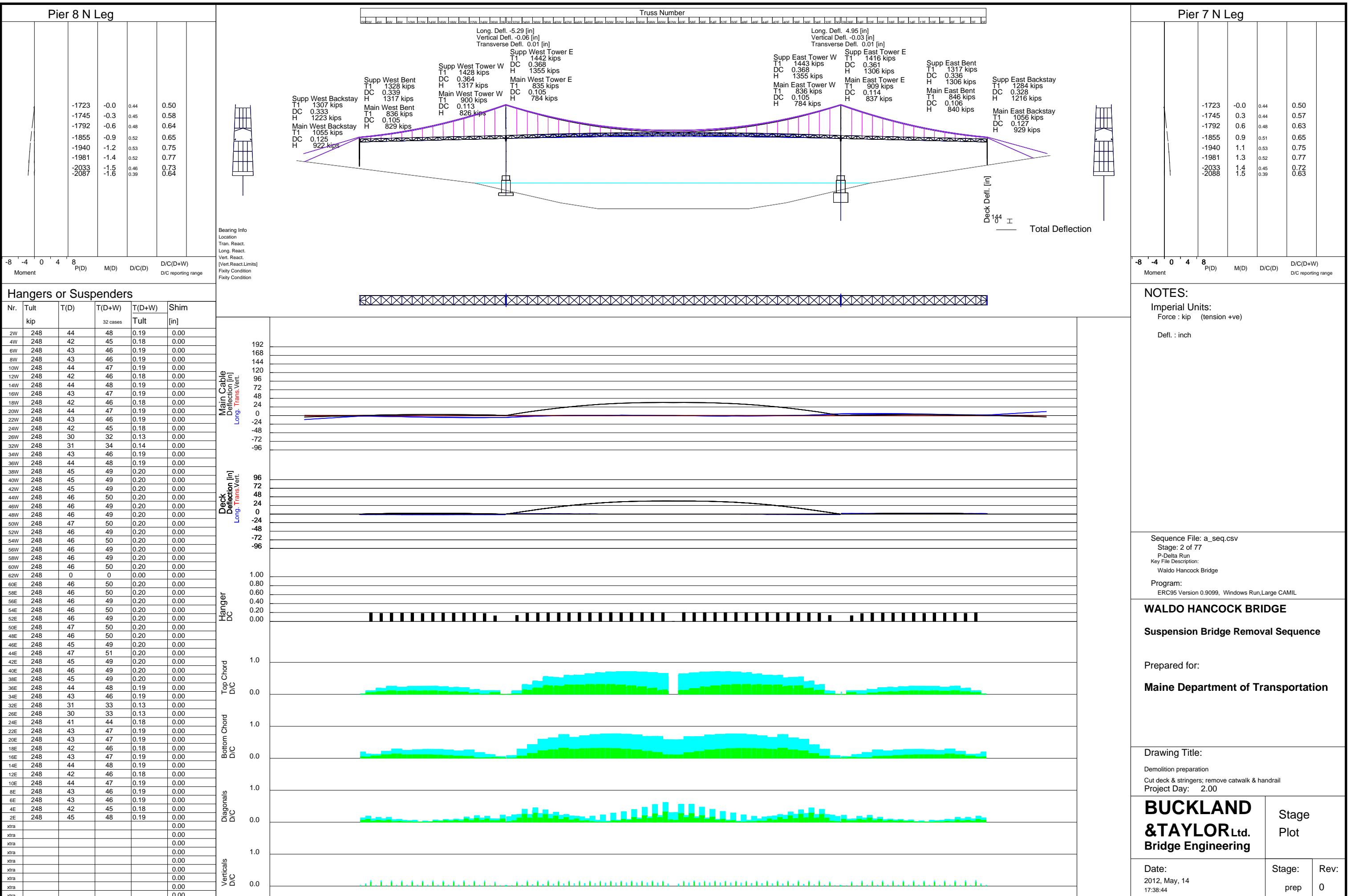
It is our understanding that the MaineDOT is responsible for assembling the complete contract package to be made available to Contractors for tender purposes. Items covered by MaineDOT in the development may include, but are not limited to:

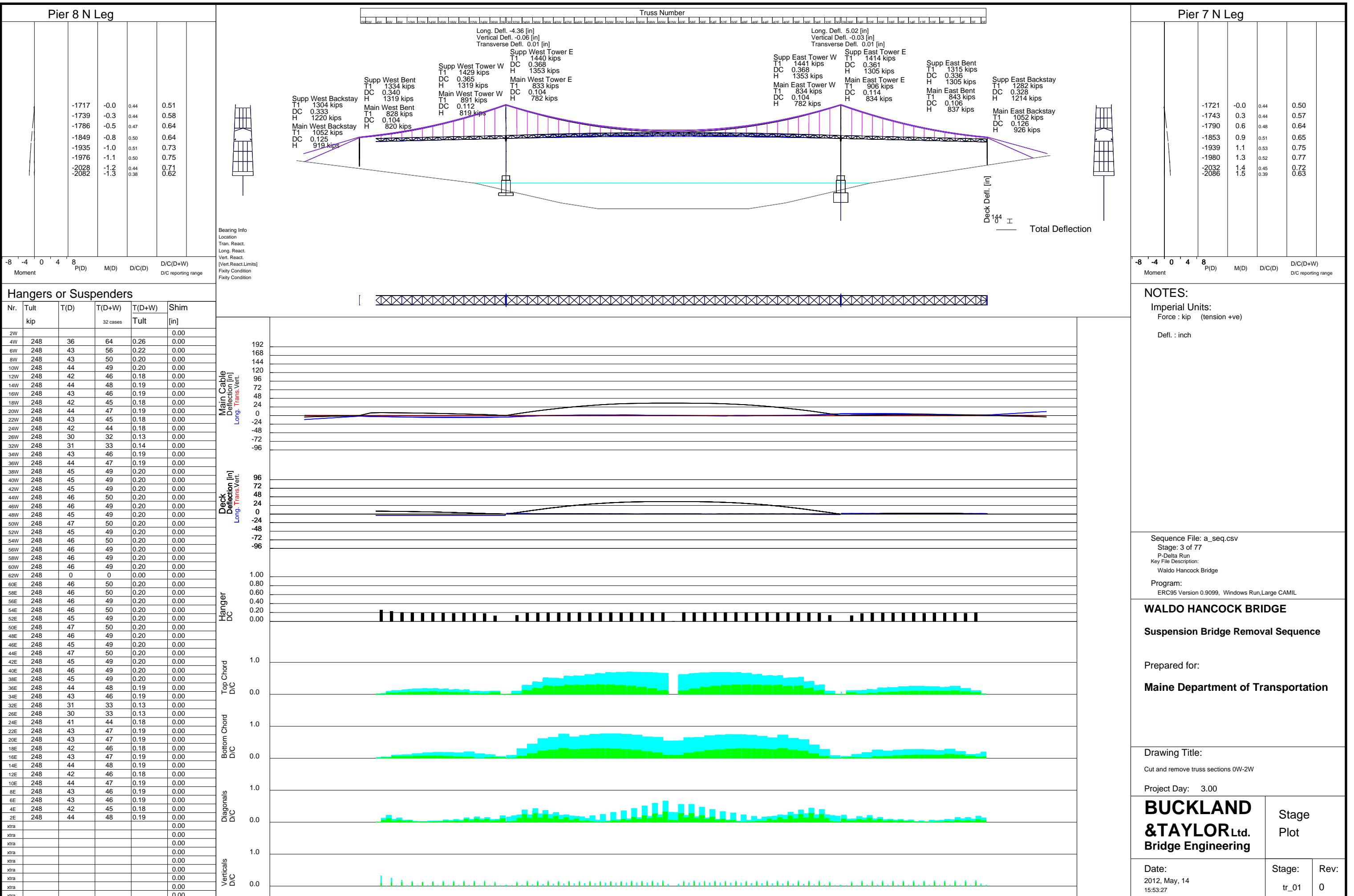
- Environmental;
- Safety;
- Project Schedule (we understand all work will be proceeding in an uninterrupted manner completed within several months)
- Schedule for review of submissions;
- Land access;
- Marine access;
- Work areas;
- Control and Protection of traffic (vehicular, boat, pedestrian) adjacent to and/or under the structure;
- Temporary structures to grade;
- Rehabilitation or removal of viaduct foundations;
- Control of debris during removals;
- Removal and disposal of all components; and
- Salvage items and storage locations on site.

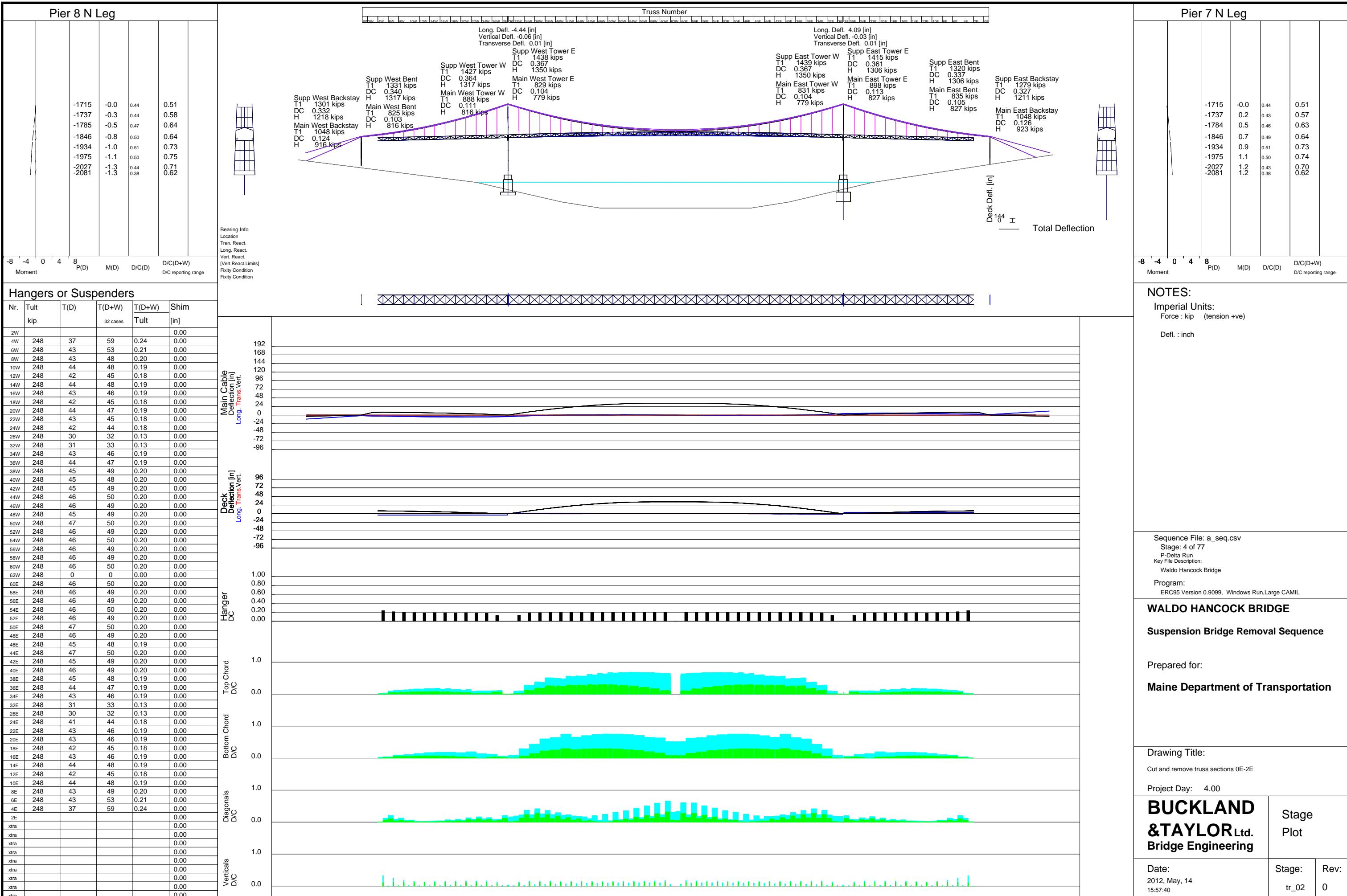
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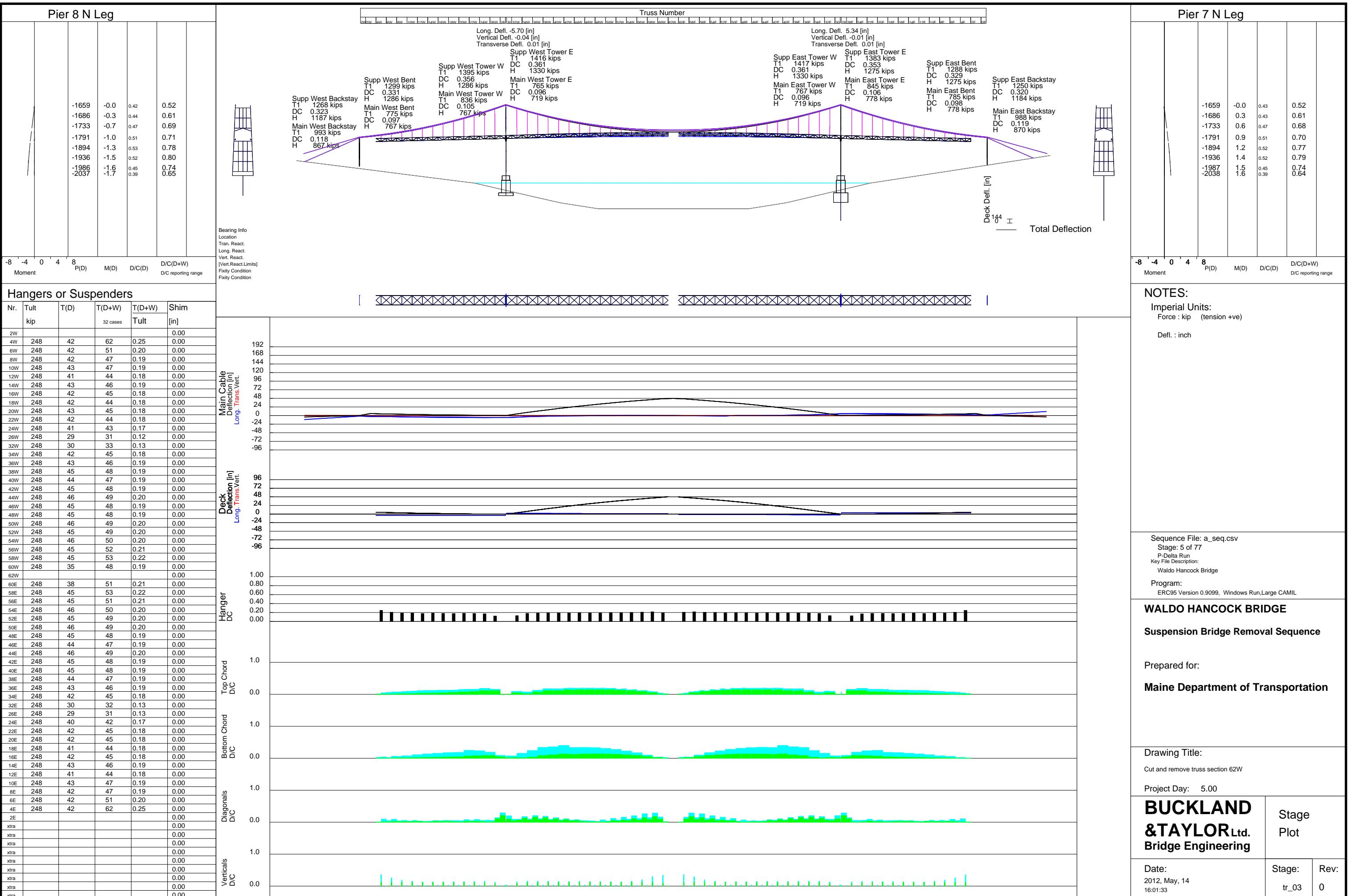
**APPENDIX A**  
**DEMOLITION SEQUENCE STAGE PLOTS**

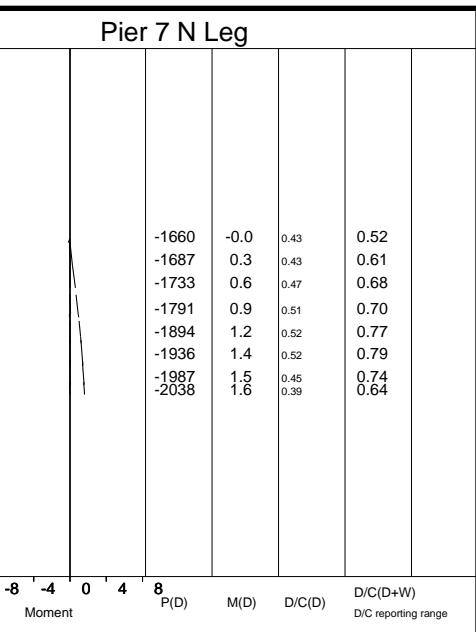
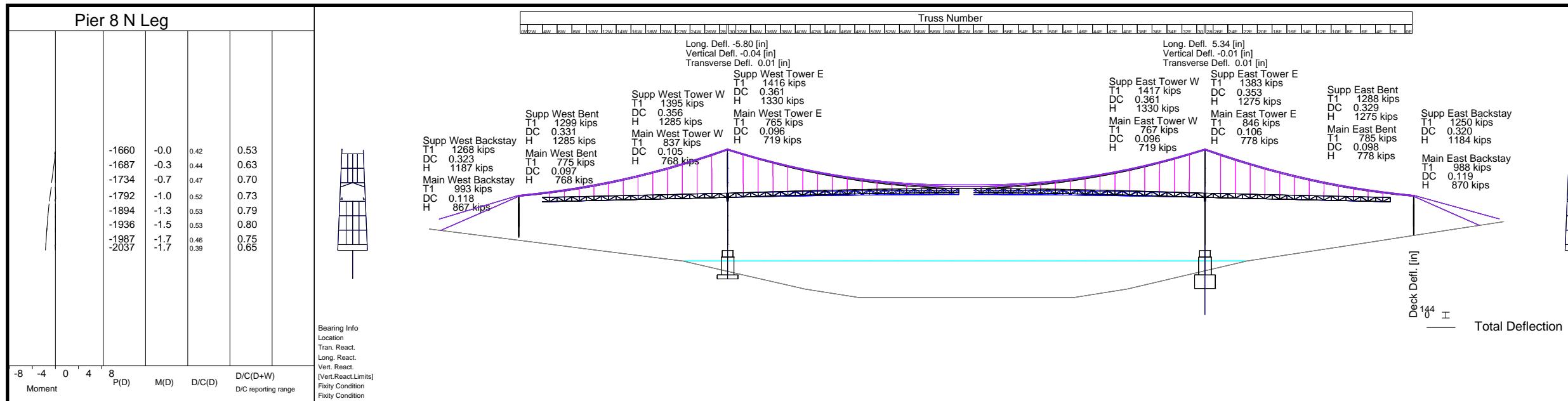












The figure displays six vertically stacked plots showing the results of a structural analysis for a bridge deck. The top plot shows the Main Cable Deflection [in] (Long. Trans. Vert.) ranging from -96 to 192 inches. The second plot shows the Deck Deflection [in] (Long. Trans. Vert.) ranging from -96 to 96 inches. The third plot shows the Hanger DC (Deflection per Centimeter) ranging from 0.00 to 1.00. The fourth plot shows the Top Chord D/C (Deflection per Centimeter) ranging from -1.0 to 1.0. The fifth plot shows the Bottom Chord D/C (Deflection per Centimeter) ranging from -1.0 to 1.0. The bottom plot shows the Vertical D/C (Deflection per Centimeter) ranging from -1.0 to 1.0. All plots share a common horizontal axis representing the longitudinal position of the bridge deck. The plots use a color scheme where black lines represent the main cable and deck deflections, blue lines represent hanger deflections, green lines represent top chord deflections, cyan lines represent bottom chord deflections, and magenta lines represent vertical deflections. The plots also include a grid of horizontal lines corresponding to the y-axis scales.

**NOTES:**

**Imperial Units:**

Force : kip (tension +ve)

Defl. : inch

---

Sequence File: a\_seq.csv  
Stage: 6 of 77  
P-Delta Run  
Key File Description:  
Waldo Hancock Bridge

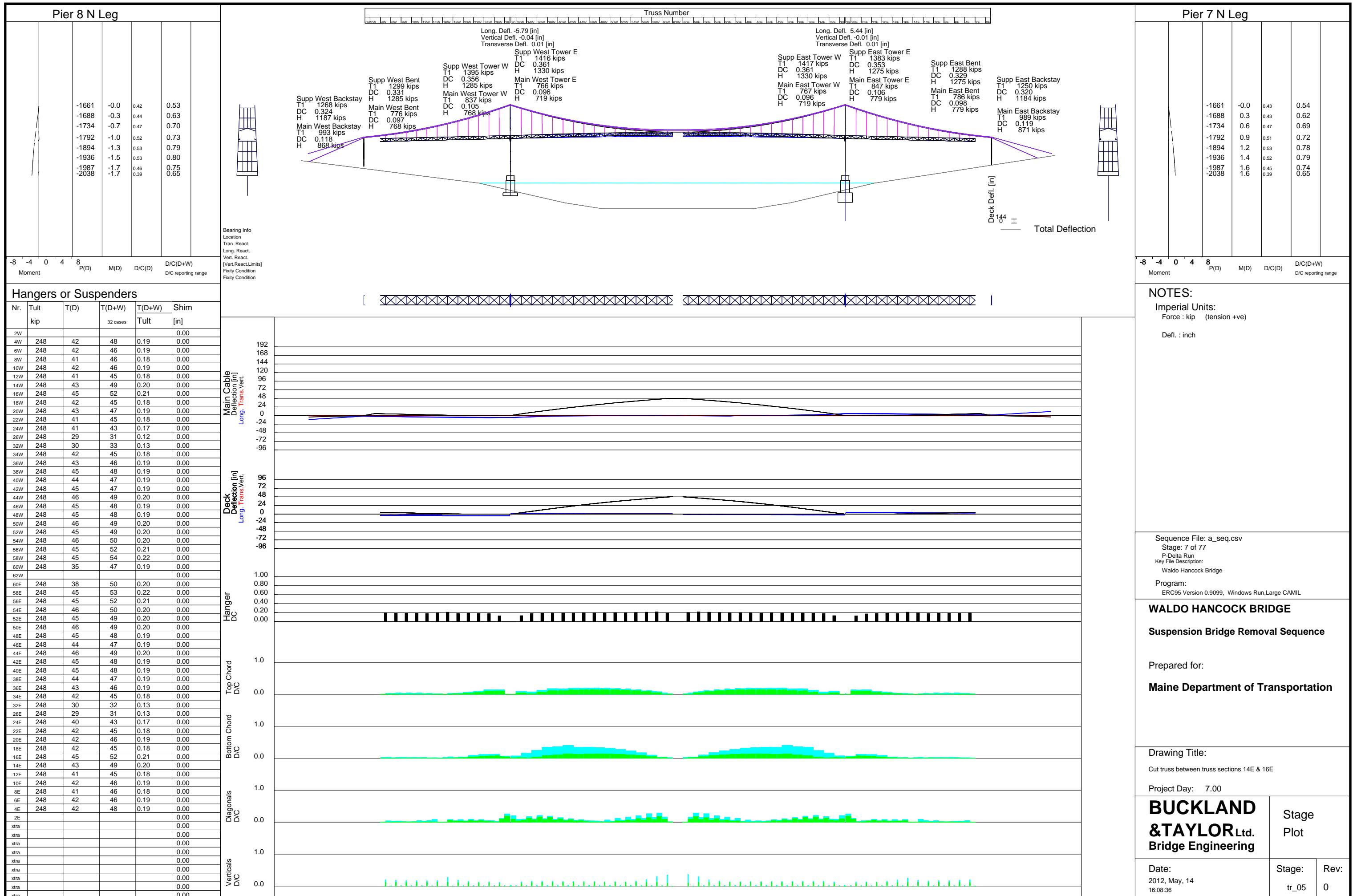
**Program:**  
ERC95 Version 0.9099, Windows Run, Large CAMIL

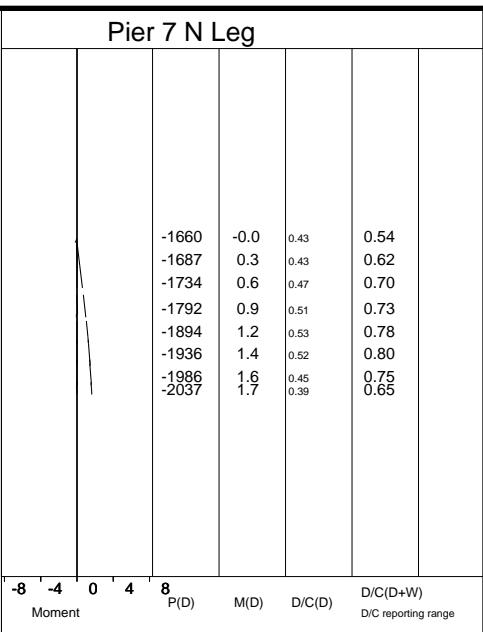
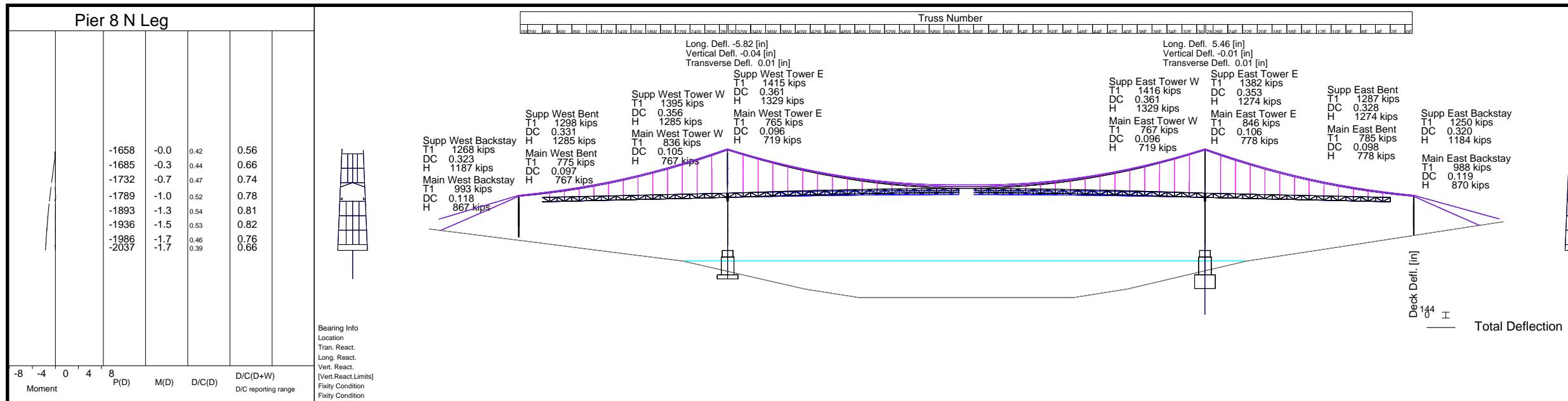
# **WALDO HANCOCK BRIDGE**

## **Suspension Bridge Removal Sequence**

Drawing Title:  
Cut truss between truss sections 14W & 16W

Project Day: 6.00	
<b>BUCKLAND &amp; TAYLOR Ltd. Bridge Engineering</b>	Stage Plot
Date: 2012, May, 14 16:04:40	Stage: tr_04
	Rev: 0





**NOTES:**

**Imperial Units:**

Force : kip (tension +ve)

Defl. : inch

Sequence File: a\_seq.csv  
Stage: 8 of 77  
P-Delta Run  
Key File Description:  
Waldo Hancock Bridge  
  
Program:  
ERC95 Version 0.9099, Windows Run, Large CAMIL

## **WALDO HANCOCK BRIDGE**

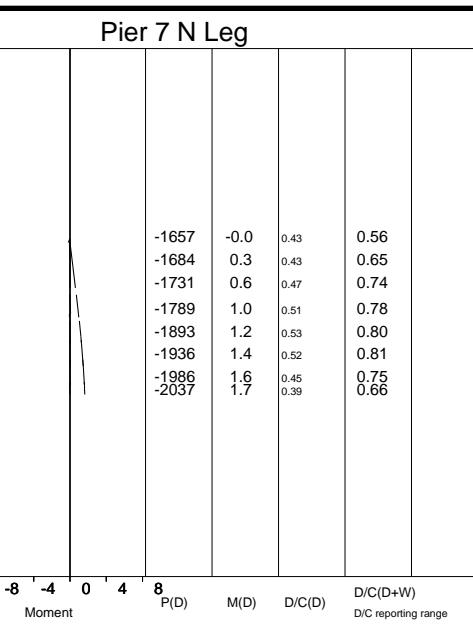
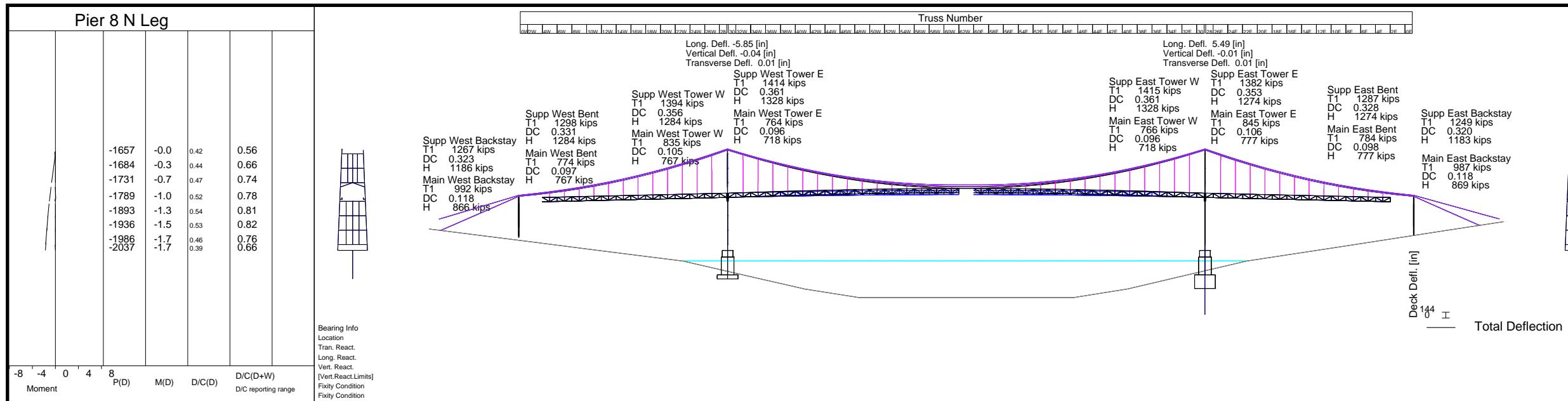
## Suspension Bridge Removal Sequence

Prepared for:

Maine Department of Transportation

**Drawing Title:**  
Cut truss between truss sections 36W & 38W

Project Day: 8.00	
<b>BUCKLAND &amp; TAYLOR Ltd. Bridge Engineering</b>	Stage Plot
Date: 2012, May, 14 16:12:38	Stage: tr_06



The figure displays five vertically stacked plots showing the results of a structural analysis for a bridge deck. The top plot shows the Main Cable Deflection [in] (Long. Trans. Vert.) ranging from -96 to 192 inches. The second plot shows the Deck Deflection [in] (Long. Trans. Vert.) ranging from -96 to 96 inches. The third plot shows the Hanger DC force (D/C) ranging from 0.00 to 1.00. The fourth plot shows the Top Chord DC force (D/C) ranging from -1.0 to 1.0. The bottom plot shows the Bottom Chord DC force (D/C) ranging from -1.0 to 1.0. All plots share a common horizontal axis representing the longitudinal position of the bridge deck. A blue line at the top of the figure indicates the bridge's longitudinal profile. The plots show various colored lines representing different components or sections of the bridge structure, such as cables, deck, hangers, top chord, bottom chord, and diagonals.

**NOTES:**

**Imperial Units:**

Force : kip (tension +ve)

Defl. : inch

---

Sequence File: a\_seq.csv

Stage: 9 of 77

P-Delta Run

Key File Description:

Waldo Hancock Bridge

**Program:**

ERC95 Version 0.9099, Windows Run, Large CAMIL

# **WALDO HANCOCK BRIDGE**

## **Suspension Bridge Removal Sequence**

Drawing Title:  
Cut truss between truss sections 36E & 38E

Project Day: 9.00	
<b>BUCKLAND</b> <b>&amp; TAYLOR Ltd.</b> Bridge Engineering	Stage Plot
Date: 2012, May, 14 16:16:34	Stage: tr_07
	Rev: 0

